इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS/IEC 60079-19 (2006): Explosive atmospheres, Part 19: Repair, overhaul and reclaation [ETD 22: Electrical Apparatus for Explosive Atmosphere]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS/IEC 60079-19 : 2006

भारतीय मानक

विस्फोटी पर्यावरण

भाग 19 उपकरणों की मरम्मत, ओवरहॉल और उद्धार करना

Indian Standard

EXPLOSIVE ATMOSPHERES

PART 19 REPAIR, OVERHAUL AND RECLAMATION

ICS 29.260.20

© BIS 2008

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2008

Price Group 14

Electrical Apparatus for Explosive Atmospheres Sectional Committee, ETD 22

NATIONAL FOREWORD

This Indian Standard (Part 19) which is identical with IEC 60079-19 : 2006 'Explosive atmospheres — Part 19: Equipment repair, overhaul and reclamation' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Electrical Apparatus for Explosive Atmospheres Sectional Committee and approval of the Electrotechnical Division Council.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60079 (all parts) Explosive atmospheres	IS/IEC 60079 (all parts) Explosive atmospheres	Identical
IEC 60085 : 1984 Thermal evaluation and classification of electrical insulation	IS 1271 : 1985 Thermal evaluation and classification of electrical insulation (*first revision*)	Technically Equivalent
IEC 60529 : 1989 Degrees of protection provided by enclosures(IP Codes)	IS 12063 : 1987 Classification of degrees of protection provided by enclosures of electrical equipment	do
ISO 4526 : 1984 Metallic coatings — Electroplated coatings of nickel for engineering purposes	IS 12393 : 1988 Electroplated coatings of nickel	do
ISO 6158 : 1984 Metallic coatings — Electrodeposited coatings of chromium for engineering purposes	IS 1337 : 1993 Electroplated coatings of hard chromium for engineering purposes (*third revision*)	do
ISO 9000 : 2005 Quality management and systems — Fundamentals and vocabulary	IS/ISO 9000 : 2005 Quality management systems — Fundamentals and vocabulary (*third revision*)	Identical

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards referred to in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC 61241-0	Electrical apparatus for use in the presence of combustible dust — Part 0 : General requirements

(*Continued on third cover*)

Indian Standard

EXPLOSIVE ATMOSPHERES

PART 19 REPAIR, OVERHAUL AND RECLAMATION

1 Scope

This part of IEC 60079

- gives instructions, principally of a technical nature, on the repair, overhaul, reclamation and modification of a certified equipment designed for use in explosive atmospheres,
- is not applicable to maintenance, other than when repair and overhaul cannot be disassociated from maintenance, neither does it give advice on cable entry systems which may require renewal when the equipment is re-installed;
- is not applicable to type of protection 'm',
- assumes that good engineering practices are adopted throughout.

NOTE Much of the content of this standard is concerned with the repair and overhaul of electrical rotating machines. This is not because they are the most important items of explosion-protected equipment but rather because they are often major items of repairable capital equipment in which, whatever type of protection is involved, sufficient commonality of construction exists as to make possible more detailed instructions for their repair, overhaul, reclamation or modification.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60085, *Electrical insulation – Thermal classification*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61241-0, *Electrical apparatus for use in the presence of combustible dust – Part 0: General requirements*

IEC 61241-2, *Electrical apparatus for use in the presence of combustible dust – Part 2: Test methods*

ISO 4526, *Metallic coatings – Electroplated coatings of nickel for engineering purposes*

ISO 6158, *Metallic coatings – Electrodeposited coatings of chromium for engineering purposes*

ISO 9000, *Quality management and systems – Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
serviceable condition
condition which permits a replacement or reclaimed component part to be used without prejudice to the performance or explosion protection aspects of the equipment, with due regard to the certification requirements as applicable, in which such a component part is used

3.2
repair
action to restore faulty equipment to its fully serviceable condition and in compliance with the relevant standard

NOTE The relevant standard means the standard to which the equipment was originally designed.

3.3
overhaul
action to restore to a fully serviceable condition equipment which has been in use or in storage for a period of time but which is not faulty

3.4
maintenance
routine actions taken to preserve the fully serviceable condition of the installed equipment (see Clause 1)

3.5
component part
an indivisible item

NOTE The assembly of such items may form equipment.

3.6
reclamation
means of repair involving, for example, the removal or addition of material to reclaim component parts which have sustained damage, in order to restore such parts to a serviceable condition in accordance with the relevant standard

NOTE The relevant standard means the standard to which the individual parts were originally manufactured.

3.7
modification
change to the design of the equipment which affects material, fit, form or function

3.8
manufacturer
maker of the equipment (who may also be the supplier, the importer or the agent) in whose name usually the certification, where appropriate, of the equipment was originally registered

3.9
user
user of the equipment

3.10
repair facility
facility providing a service that consists of repairs, overhauls, or reclamations of explosion-protected equipment who may be the manufacturer, the user or a third party (repair agency)

3.11
certification
certification leading to the issue of a certificate of conformity which refers primarily to assessments of equipment carried out by a recognized testing authority

This standard may also apply to equipment certified by other certification authorities, or to equipment which has been self-certified by manufacturers or users as complying with recognized standards.

3.12
certificate references
a certificate reference number may refer to a single design or a range of equipment of similar design

3.13
symbol "X"
the symbol "X" is used to denote special conditions of safe use. The certification documents need to be studied before such equipment is installed, repaired, overhauled, reclaimed or modified.

3.14
copy winding
process by which a winding is totally or partially replaced by another, the characteristics and properties of which are at least as good as those of the original

3.15
type of protection "d"
type of protection in which parts which can ignite an explosive atmosphere are placed in an enclosure which can withstand the pressure developed during an explosion of an explosive mixture and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure

3.16
type of protection "i"
circuit in which no spark or any thermal effect produced in the test conditions prescribed in the relevant standard(s) (which include normal operation and specific fault condition) is capable of causing ignition of a given explosive atmosphere

3.17
type of protection "p"
type of protection by which the entry of a surrounding atmosphere into the enclosure of the electrical equipment is prevented by maintaining, inside the said enclosure, a protective gas at a higher pressure than that of the surrounding atmosphere. The overpressure is maintained either with or without a continuous flow of the protective gas.

3.18
type of protection "e"
type of protection by which measures are applied so as to prevent, with a higher degree of security, the possibility of excessive temperatures and the occurrence of arcs or sparks in the interior and on the external parts of the electrical equipment which would not produce them in normal service

3.19

type of protection "n"

type of protection applied to the electrical equipment such that, in normal operation, it is not capable of igniting the surrounding explosive atmosphere and that a fault capable of causing ignition is not likely to occur

3.20

type of protection "tD"

type of protection for explosive dust atmospheres where electrical equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures

3.21

type of protection "pD"

type of protection reliant upon the enclosure being subjected to a continuous pressure, according to IEC 61241-2, from a supply of uncontaminated air or other non-flammable gas while electricity is connected to the enclosure

4 General

4.1 General principles

This clause covers those aspects of repair, overhaul, reclamation and modification which are common to all explosion-protected equipment. Subsequent clauses provide instructions for the additional requirements relevant to specific types of protection. When equipment incorporates more than one type of protection, reference shall be made to the appropriate clauses.

NOTE 1 Additional requirements for types of protection "o" and "q" have not been defined.

Assuming that repairs and overhauls are carried out using good engineering practices, then

a) if manufacturers' specified parts or parts as specified in the certification documentation are used in a repair or overhaul, the equipment is presumed to be in conformity with the certificate;

b) if repairs or modifications are carried out on the equipment specifically as detailed in the certification documents, the equipment should still conform with the certificate.

In circumstances where the certification documents are not available, then the repair or overhaul shall be carried out on the equipment in accordance with this standard and other relevant standard(s). The steps taken to obtain the certification documents shall be recorded in the repair facility records (see 4.4.1.5.3).

If other repair or modification techniques are used which are not in accordance with this standard, then it will be necessary to ascertain, from the manufacturers, and/or the certification authority, the suitability of the equipment for continued use in an explosive atmosphere.

NOTE 2 Repair of equipment which has no marking plate should be avoided.

4.2 Statutory requirements

4.2.1 Repair facility

The repair facility shall be aware of any specific requirements in relevant national legislation which may govern the repair or overhaul operation.

4.2.2 User

The equipment user should be aware of any relevant legislation should he wish to undertake the repair or overhaul of equipment himself In addition, he should be aware of any changes in responsibility for health and safety, should refurbishment and/or re-installation be carried out by a third party.

4.3 Instructions for the user

4.3.1 Certificates and documents

The equipment design certificate and other related documents (see 4.4.1.5.1) should be obtained as part of the original purchase contract.

4.3.2 Records and work instructions

All relevant documentation that is available shall be obtained as part of the original purchase contract. Records of any previous repairs, overhauls or modifications shall be kept by the user and made available to the repairer

NOTE It will be in the interests of the user that the repairer is notified, whenever possible, of the fault and/or nature of the work to be done.

Special requirements stipulated in the user's specifications, and which are supplementary to the various standards, e.g. enhanced ingress protection, shall be brought to the attention of the repairer.

The user shall inform the repairer of any statutory requirement for compliance with certification (see note in the introduction).

4.3.3 Re-installation of repaired equipment

Before the repaired equipment is re-commissioned, cable/conduit entry systems shall be checked to ensure that they are undamaged and are appropriate to the equipment type of protection. Recommendations may be found in the wiring systems clause of IEC 60079-14

4.3.4 Repair facilities

The user shall ascertain that the repair facility concerned can demonstrate compliance with the relevant stipulations of this standard.

4.4 Instructions for the repair facility

4.4.1 Repair and overhaul

4.4.1.1 General

Repair facilities shall operate a Quality Management System that meets with the requirements of the ISO 9000 series of standards.

The repair facility shall appoint a person ('Responsible Person') with the required competency (see Annex B), within the management organization, to accept responsibility and authority for ensuring that the overhauled/repaired equipment complies with the certification status agreed with the user. The person so appointed shall have a working knowledge of the appropriate explosion protection standards and an understanding of this standard.

The repair facility must have adequate repair and overhaul facilities as well as the appropriate equipment necessary and trained Operatives with the required competency (see Annex B) and authority to carry out the activities, taking into account the specific type of protection.

The repair facility shall conduct an assessment of the status of the equipment to be repaired, agree with the user the expected certification status of the equipment after repair and the scope of work to be done. This should include the omission of any tests mentioned within this document that the user could reasonably assume to be included. The assessment shall be documented and shall address the relevant clauses of the appropriate equipment standard and this standard and be included in the job report to the user. Such assessments shall be conducted by the Responsible Person (supported by appropriate Operatives). The Responsible Person shall only conduct assessments with the explosion protection techniques for which he has demonstrated his competence.

The repair facility shall include procedures and systems to carry out overhaul/repair work at sites external to the repair facility, where appropriate.

4.4.1.2 Certification and standards

The repairer's attention is directed to the need to be informed of, and to comply with, the relevant explosion-protection standards and certification requirements applicable to the equipment to be repaired or overhauled.

4.4.1.3 Competency

The repairer of the equipment shall ensure that those operatives directly concerned with the repair and/or overhaul of the certified equipment are trained, experienced, skilled, knowledgeable and/or supervised on this type of work.

Training and competency assessments are specified in Annex B.

Appropriate training and assessment shall be undertaken from time to time at intervals depending on the frequency of utilization of the technique or skill and change of standards or regulations. The interval should normally not exceed three years.

4.4.1.4 Testing

Should it prove impracticable to carry out certain tests, e.g., a component of a complete equipment taken off site for repair such as a rotor of a rotating machine, the repairer shall, before putting the repaired equipment back into service, ascertain from the user or manufacturer the consequences of omitting such tests.

NOTE In some countries, legal consequences may depend upon the extent to which the carrying out or not of certain actions or tests is practicable.

4.4.1.5 Documentation

4.4.1.5.1 General

The repair facility should seek to obtain all necessary information/data from the manufacturer or user for the repair and/or overhaul of the equipment. This may include information relating to previous repairs, overhauls or modifications. He should also have available and refer to the relevant explosion-protection standard.

The data available for the repair and/or overhaul should include but need not be limited to, details of the

- technical specification;
- drawings,
- explosion protection performance and conditions of use,
- dismantling and assembly instructions;
- certificate limitations (special conditions for safe use), where specified;
- marking (including certification marking),
- recommended methods of repair/overhaul for the equipment,
- list of spare parts.

The information may be subject to amendments including those relative to certification

NOTE 1 It is not reasonably practicable to assume that adequate information is, or can be, so widely circulated that it is always available where and when it is needed Sources of adequate information are users, manufacturers or certifying authorities.

NOTE 2 As from IEC 60079-0 (Edition 4), manufacturers are required to give instructions including repair

The repair facility shall maintain controlled copies of any relevant explosion protection standards with which repaired/overhauled equipment is claimed to comply

4.4.1.5.2 Job report to the user

At the completion of the work, job reports shall be submitted to the user (see 4 3 2) containing, at least, the following

- details of fault detected;
- full details of repair and overhaul,
- list of replaced or reclaimed parts,
- results of all checks and tests (in sufficient detail to be useful if required by the next repairer, see 4 3 2);
- summary of previous history of the repaired product including information as gathered under 4.3.2;
- copy of the user contract or order.

The job reports of repairs/overhauls shall be retained for a period of time as agreed with the user. Retained information shall be adequately controlled to ensure correct retrieval

4.4.1.5.3 Repair facility records

The following records shall be retained by the repair facility

- current and past copies of relevant Technical Standards;
- certification of Facility Quality Standard including
  1) details of Repair provider's Quality Assessment Scheme;
  2) test instrument calibration,
  3) competency and training records of personnel;
  4) purchasing control system;
  5) customer complaints system,

  6) internal and, where appropriate, external audit documentation;
  7) management review;
  8) process control procedures;
  9) register of manufacturer's drawings;
- job records including:
  1) the steps taken to obtain the certification documents;
  2) mechanical inspection record for compliance with relevant standards;
  3) defect identification;
  4) electrical test records before and after repair including traceability of instruments used and pass/fail criteria;
  5) certificates of conformity for replacement components;
  6) recovery procedure for repaired components;
  7) record of mechanical inspection during assembly and upon completion;
  8) record of work undertaken by the repair facility.

The record of the recovery procedure for repaired components should, at least, identify the following:

a) a detailed justification for the work carried out;
b) various options considered (e.g., welding, metal spraying);
c) technical parameters, e.g., bond strength;
d) the reasons for selecting the chosen technique;
e) consumables used and method of storage;
f) base material;
g) manufacturers' instructions considered;
h) procedure utilized;
i) identity and competency of the operator;
j) inspection procedure used, e.g., ultra-sonic, dye-penetration, X-ray;
k) maintenance and calibration details of automatic systems.

These records shall be retained for a period of at least ten years or as agreed with the user.

4.4.1.6 Spare parts

4.4.1.6.1 General

It is preferable to obtain new parts from the manufacturer, and the repairer shall ensure that only appropriate spare parts are used in the repair or overhaul of certified equipment. Depending on the nature of the equipment, these spare parts may be identified by the manufacturer, the equipment standard or the relevant certification documentation.

4.4.1.6.2 Sealed parts

Parts, which are required by the equipment specification and certificate documents to be sealed, shall be replaced only by the particular spare part(s) detailed in the parts list.

NOTE Devices incorporated in equipment to indicate interference by third parties (e g , security seals) as distinct from those required in the certification documents, are not intended to fall within the scope of this subclause

4.4.1.7 Identification of repaired equipment

The equipment shall be marked to identify the repair or overhaul and the repairer's identity The marking for the repaired equipment is given in Annex A.

Marking may be provided on a separate label It may be necessary to amend or remove or supplement the label in certain circumstances as follows

a) If after repair, overhaul or modification, an equipment is changed such that it no longer conforms with the standard and certificate (see 3 11), the certification label shall be removed unless a supplementary certificate has been obtained

b) If the equipment is changed during repair or overhaul so that it still complies with the restrictions imposed by this standard and the explosion protection standards to which it was manufactured, but does not necessarily comply with the certificate, the certification label should not normally be removed and the repair symbol "R" shall be written within an inverted triangle (see Annex A).

c) Where the standards to which the previously certified equipment was manufactured are not known, the requirements of this standard and the current edition of the relevant explosion protection standards shall apply. An assessment, by a person competent in assessing explosion protected equipment, shall be conducted to verify compliance with the relevant level of safety prior to release of the equipment by the repairer.

4.4.2 Reclamations

4.4.2.1 General

Reclamations not affecting the explosion protection are not the subject of this subclause. Such parts should be reclaimed using good engineering practices.

Where the repair process involves reclamation work, then, in addition to the requirements of 4 4 1 for repairs and overhauls, the requirements of 4 4 2 also apply.

4.4.2.2 Exclusions

Some component parts are considered not to be reclaimable and are therefore excluded from the scope of this standard, such as:

- component parts made from the following materials: glass, plastics, or any material that is not dimensionally stable;
- fasteners;
- component parts, e g., some encapsulated assemblies, which have been stated by the manufacturer to be not subject to repair.

4.4.2.3 Requirements

4.4.2.3.1 General

Any reclamation shall be carried out by competent personnel, skilled in the process to be employed and using good engineering practices (see Annex B). Operators of reclamation techniques, e.g. welding, metal spraying, shall be required to undertake a practical skill test in the technique before being permitted to utilize the technique for the first time and every three years thereafter. If the operator has not used the technique in the previous six months, he shall undertake a re-test.

If any proprietary process is used, the instructions of the originator of such a process should be followed.

All reclamation shall be properly documented and records retained. Such records include:

- identification of the component part;
- method of reclamation;
- detail of any dimensions which differ from those in relevant certification documents or the original dimensions of the component part;
- drawing showing reclamation details including material removed and replaced;
- date;
- name of the organization carrying out the reclamation.

If the reclamation is carried out other than by the user, the user shall be provided with a copy of the record.

A reclamation procedure which would result in dimensions affecting explosion-protection integrity being different from those given in relevant certification documents may be permissible if such changed dimensions still meet the requirements of the restrictions imposed by this standard and the explosion protection standards to which it was manufactured. The certification label should not be removed and the repair symbol "R" shall be written within an inverted triangle. Where the standards to which the previously certified equipment was manufactured are not known, the requirements of this standard and the current edition of the relevant explosion protection standard shall apply. An assessment, by a person competent in assessing explosion protected equipment shall be conducted to verify compliance with the relevant level of safety prior to release of the equipment by the repairer.

In the event of any uncertainty regarding the permissibility, from an explosion-protection safety point of view, of an intended reclamation procedure, the advice of the manufacturer or certifying authority should be sought. It may also be necessary to carry out tests to verify that the reclamation procedure is acceptable.

4.4.2.3.2 Responsibilities

If reclamations are contracted out by the repair facility to a specialized industry, such reclamations shall be the responsibility of the repair facility.

4.4.2.4 Reclamation procedures

4.4.2.4.1 General

The following outlines some of the reclamation procedures which may be applicable to explosion-protected equipment.

It should be recognized that not all procedures are applicable to all types of protection. Detailed instructions are given in the appropriate clauses of this standard.

Metal removal shall be minimized and be just sufficient to remove the defect requiring repair and provide the minimum coating thickness recommended for the technique used. Industry guidance would suggest that the removal of up to 2 % of metal thickness for metal spraying and up to 20 % for welding will not be significantly detrimental to the strength of the component. Removal of a greater thickness of material shall only be carried out after due consultation with the manufacturer or by calculation where the manufacturer is no longer available.

On completion of the reclamation, the repairer shall satisfy himself that the equipment is in a fully serviceable condition and complies with the standard(s) for the type of protection. Such compliance shall be recorded by the repair facility and retained in the job files.

4.4.2.4.2 Metal spraying

This method shall be used only when the extent of the wear or damage, plus the machining necessary to prepare the component part for reclamation, does not weaken the part beyond safe limits. A sprayed metal inlay, whilst adding some stiffness, should not be taken into account when strength is considered. Indeed, the machining process prior to the application of metal spray may introduce stress raisers which may further weaken the component.

Metal spraying is not recommended for some high-speed and large-diameter applications, it is only acceptable where the materials are metallurgically compatible and the parent base metal is free from defects.

4.4.2.4.3 Electroplating

Electroplating is an acceptable procedure provided that the part is not weakened beyond safe limits. Detailed procedures for chromium and nickel plating are given in ISO 6158 and ISO 4526, respectively.

4.4.2.4.4 Sleeving

This method shall be used only when the extent of the wear and damage, plus the machining necessary to prepare the part for reclamation, does not weaken the part beyond safe limits. A sleeve, whilst adding some stiffness, should not be taken into account when strength is considered.

4.4.2.4.5 Brazing and welding

Reclamation by brazing or welding shall be considered only if the technique employed ensures the correct penetration and fusion of braze or weld with parent metal, resulting in adequate reinforcement, the prevention of distortion, the relief of stresses and the absence of blow-holes. It should be recognized that brazing and welding raise the temperature of the component to a high level and may cause fatigue cracks to propagate.

The following welding techniques are recognised by this standard:

- MMA: Manual Metal Arc
- MIG: Metal Inert Gas
- TIG: Tungsten Inert Gas
- Sub-Arc: MIG under a layer of flux
- Hot wire

Other techniques shall only be utilized in reclamations after due consultation with the manufacturer or, if relevant, the certifying authority.

4.4.2.4.6 Metal stitching

The cold reclamation of a fractured casting by the technique of closing the fracture with nickel alloy stitches and sealing the crack by nickel alloy chain studding may be admissible subject to a suitable thickness of casting.

4.4.2.4.7 Machining of stator and rotor cores (rotating machines)

Damaged stator or rotor cores shall not be machined to remove surface irregularities without reference to the manufacturer to ascertain the maximum permissible air gap which shall not be exceeded.

NOTE This restriction could affect the practicability of fitting a new shaft into an existing core, the core then requiring trueing up to restore concentricity.

4.4.2.4.8 Threaded holes for fasteners

Threads which have been damaged beyond an acceptable extent may be reclaimed, depending upon the type of protection, by the following means:

- oversize drilling and re-tapping;
- oversize drilling, re-tapping and the fitting of a proprietary thread insert which passes the appropriate pull test as specified by the thread insert manufacturer;
- oversize drilling, plugging [1], re-drilling and re-tapping;
- plugging [2], re-drilling and tapping elsewhere;
- plug-welding, re-drilling and tapping.

4.4.2.4.9 Re-machining

Re-machining worn or damaged surfaces shall be considered only if

- the component part is not weakened beyond safe limits;
- provided that the integrity of the enclosure is maintained;
- the required surface finish is achieved.

4.4.3 Modifications

Where the repair process involves modification work, then, in addition to the requirements of 4.4.1 for repairs and overhauls, the requirements of 4.4.3 also apply.

No modification shall be made to the certified equipment unless that modification is permitted in the certificate or is approved in writing by the manufacturer. Subsequent clauses of this standard give detailed instructions regarding modifications in the context of different types of protection.

Where a modification is proposed which would result in the equipment not conforming with the certification documents and the relevant type of protection standards, the user shall be informed in writing that the equipment is no longer suitable for use in an explosive atmosphere, and his written instructions obtained. If the proposal is carried out, the certification label shall be removed or altered to give a clear indication that the equipment is not certified.

---

[1] Plugs shall be securely retained.

[2] Plugs shall be securely retained.

4.4.4 Temporary repairs

A temporary repair intended to achieve continued short-term operation of the equipment shall only be carried out if retention of explosion-protection aspects is ensured or other appropriate measures are taken until the equipment is fully restored. Certain temporary repair procedures may therefore not be allowed. Any temporary repair shall be brought up to full repair standards as soon as reasonably practicable.

4.4.5 Removal of damaged windings

The procedure of softening the impregnating varnish of windings with solvents before stripping is acceptable.

The alternative procedure which uses the application of heat to facilitate the removal of windings is acceptable provided that the operation is carried out with caution so as not to affect significantly the insulation between the laminations of magnetic parts. Particular caution is necessary, and if in doubt, the advice of the manufacturer will be sought regarding the construction of the core and the inter-laminar insulation material with respect to equipment with type of protection "e" and equipment with any type of protection having temperature class T6, T5 or T4.

The need for particular caution in those circumstances arises from the fact that an increase in core loss, which could result from degradation of inter-laminar insulation, could significantly affect type "e" parameters (t_E-time, etc.) or result in the temperature classification being exceeded. The repairer shall satisfy himself, as in all reclamation procedures, that on completion of the reclamation the equipment is in a fully serviceable condition and complies with the standard(s) for the relevant explosion concept (see also 4.4.2.4).

4.4.6 Inverters

Particular attention is drawn to the need for care when adding an inverter to an Ex-rotating machine in ensuring that this is only done when the intended combination of inverter and rotating machine is specified in the certificate or in the rotating machine manufacturer's documentation. Third-party repairers should use special care to establish that any inverter on which they are asked to work is so specified.

5 Additional requirements for the repair and overhaul of equipment with type of protection "d" (flameproof)

5.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "d". It should be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which should be referred to when repairing or overhauling an Ex "d" equipment are those to which the equipment was originally manufactured (see IEC 60079-1).

5.2 Repair and overhaul

5.2.1 Enclosures

It is preferable to obtain new parts from the manufacturer. Particular attention shall be paid to the correct assembly of flameproof enclosures after repair or overhaul, in order to ensure that the flameproof joints comply with the requirements of the standard and, where appropriate, with the certification documents. Where flameproof joints are not gasketed, they may be protected by the use of grease, non-setting sealing compound or non-hardening tape applied externally in accordance with IEC 60079-14.

Where gaskets which are not part of the flamepath are incorporated into the flameproof joints, replacements shall be of the same materials and dimensions as the original. Any proposed change of material shall be referred to the equipment manufacturer, user or certification authority

The drilling of holes into an enclosure is a modification and shall not be carried out without reference to the manufacturer's certified drawings, or, in exceptional circumstances, e.g., manufacturer discontinued trading, to the certifying authority.

Care shall be taken when changing surface finish, paint, etc., as this may affect the surface temperature of the enclosure and thus the temperature classification.

Before a rewound or repaired rotating machine is put back into service, it is essential to ensure that fan cover ventilation holes are not blocked or damaged so as to impair the passage of cooling air over the machine, and that any fan clearances are in compliance with the requirements of the equipment standards, if appropriate. Should a fan or fan cover be damaged so as to require renewal, the replacement parts shall be obtained from the manufacturer. If unobtainable, then they shall be of the same dimensions and at least the same quality as the original parts. They shall, where appropriate, take account of the requirements of the equipment standard to avoid frictional sparking and electrostatic charging, and of the chemical environment in which the machine is used.

5.2.2 Cable and conduit entries

Entries into flameproof enclosures shall conform, after repair or overhaul, to the conditions detailed in the appropriate equipment standard and/or certification documents where applicable.

5.2.3 Terminations

Care shall be taken when refurbishing terminations to maintain clearance and creepage distances. Any replacement terminals, bushings or parts should be obtained from the manufacturer or shall conform to the relevant equipment standard and/or certification documents, where applicable.

5.2.4 Insulation

A class of insulation the same as, or superior to, that originally provided may be employed, e.g., a winding insulated with class E material may be repaired using class F material (see IEC 60085)

5.2.5 Internal connections

There are no particular requirements relating to this type of protection but repairs to internal connections shall be of a standard at least equivalent to that of the original design.

5.2.6 Windings

5.2.6.1 General

The original winding data shall preferably be obtained from the manufacturer. If this is not reasonably practicable then use may be made of copy winding techniques. The materials used in rewinding shall comprise an appropriate insulation system. If superior insulation is proposed compared to that of the original, the rating of the winding shall not be increased without reference to the manufacturer, as the temperature classification of the equipment could then be adversely affected.

5.2.6.2 Repair of rotating machine rotors

Faulty die-cast aluminium rotor cages shall be replaced by new rotors obtained from the manufacturer or his distributor. Bar-wound cage rotors may be rewound using similar materials of identical specification. Particular care is necessary to ensure that, when replacing conductors in a cage rotor, such conductors are tight in the slots. The method of achieving tightness employed by the manufacturer should be adopted.

5.2.6.3 Testing after repair of windings

5.2.6.3.1 General

Windings, after complete or partial repair, shall be subjected, preferably with the equipment assembled, to the following tests, as far as is reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. In the case of three-phase windings, the resistance of each phase or between line terminals shall be balanced. Unbalance (i.e. the difference between the highest and the lowest values) shall be less than 5 % of middle value.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. A minimum test voltage of 500 V d.c. is recommended.

   Minimum acceptable insulation resistance values are a function of rated voltage, temperature, type of equipment and whether the rewind is partial or complete.

   NOTE The insulation resistance should not be less than 20 MΩ at 20 °C on a completely rewound equipment intended for use up to 690 V.

c) A high-voltage test in accordance with a relevant standard shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.

d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value shall be compared with that derived from the manufacturer's data, where available, and in three-phase systems shall be balanced in all phases, as far as is reasonable.

e) High-voltage (e.g., 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair or overhaul contract.

5.2.6.3.2 Rotating machines

Rotating machines, in addition to the above tests, shall be subjected to the following tests, as far as is reasonably practicable.

a) The machine shall be run at full speed and the cause of any untoward noise and/or vibration investigated and corrected.

b) The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75 % and 125 % of full-load current and to check balance on all phases. (The test, which in some respects is an alternative to a full-load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.) Unbalance shall be less than 5 % of middle value .

c) High-voltage (e.g., 1 000 V a.c./1 500 V d.c., and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE Guidance on test voltages and additional tests for rotating machines is given in IEC 60034.

5.2.6.4 Temperature sensors

If temperature sensors are included to monitor winding temperatures, it is recommended that they are embedded in the winding before varnishing and curing.

5.2.7 Auxiliary equipment

5.2.7.1 Flameproof brake units

Where a flameproof brake unit attached to a rotating machine is also certified and is in need of repair, it is recommended that it be returned to the manufacturer, together with the machine. This course is recommended because of the close construction constraints. However, such repairs are possible by repair facilities other than those of the manufacturer providing the repair facility is in possession of the necessary drawings and information from the manufacturer.

5.2.7.2 Other auxiliary devices

Where auxiliary devices are based on different types of protection, the corresponding clauses of this standard shall be consulted before any repairs are undertaken.

5.2.8 Light-transmitting parts

No attempt shall be made to re-cement or repair light-transmitting parts, and only complete replacement assemblies, as specified by the manufacturer, shall be used. Light-transmitting or other parts made from plastics shall not be cleaned with solvents. Household detergents are recommended for this purpose.

5.2.9 Encapsulated parts

In general, encapsulated parts (e.g. switching devices) are not considered suitable for repair.

5.2.10 Batteries

Where batteries are used, the manufacturer's advice shall be followed.

5.2.11 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

NOTE The position of a reflector, if any, or the distance between the lamp and the window should be maintained.

5.2.12 Lampholders

Replacements listed by the manufacturer shall be used.

5.2.13 Ballasts

Chokes or capacitors shall be replaced only by the manufacturer's listed parts, unless reference is made to the manufacturer to determine if alternatives may be used.

5.3 Reclamation

Reclamations using the techniques detailed in 4.4.2 may be used with type of protection "d" equipment subject to the following restrictions of this clause.

5.3.1 Enclosures

5.3.1.1 General

Reclaimed component parts of flameproof enclosures should be used only if they pass, when appropriate, the applicable over-pressure test. Metal stitching shall not be used

Damage to components which are not an integral part of the flameproof enclosure, for example, fixing lugs, may be repaired by welding or metal stitching but care should be taken to ensure that the integrity and stability of the equipment is not impaired. It is particularly important to check that any cracks being repaired do not extend to the flameproof enclosure

The efficacy of reclaiming or repairing by the technique of welding may be further compounded by considerations of different base materials, for example, aluminium or steel. If uncertainty exists, the repairer shall seek advice, preferably from the manufacturer, before this technique is adopted. Welding of cast-iron flameproof enclosures is not permitted without the approval of a metallurgical expert.

5.3.1.2 Flameproof joints

Damaged or corroded flameproof joint faces should be machined, after consultation with the manufacturer wherever possible, only if the resultant joint gap and flange dimensions are not affected in such a way that they contravene the certification documents. If the certification documents are not available, further guidance shall be taken from Annex C

a) Flanged joints: Welding, electroplating and re-machining flanged joint faces may be permissible, having due regard to the limitations of the technique (see Clause 4). The use of metal-spraying techniques is permissible provided the bond strength is greater than 40 MPa.

b) Spigoted/cylindrical joints: Machining the male part will require addition of metal to it, and also machining of, the female part (or vice versa), thus ensuring that the flamepath dimensions comply with the equipment standard, and where appropriate the certification documents. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal may be by electroplating, sleeving or welding, but metal spraying techniques which have a bond strength less than 40 MPa are not recommended.

c) Threaded joints:

  i) Cable and conduit entries: It is not recommended that damaged male threaded parts be reclaimed; new components shall be used. Damaged female threads may be reclaimed using MMA, MIG and TIG welding techniques.

  ii) Screwed covers: Reclamation of the threaded parts of screwed covers and of the associated housings may be possible utilizing MMA, MIG and TIG welding techniques.

5.3.1.3 Threaded holes for fasteners

Reclamation of damaged threaded holes shall be carried out using the techniques described in 4.4.2.4.8 taking into account the requirements given in 5.3.1.1.

5.3.2 Sleeving

Care should be taken not to introduce an additional effective flamepath. The sleeve shall be securely retained.

5.3.3 Shafts and housings

Shafts and bearing housings, including flameproof joints, may be reclaimed by the use of electroplating, metal spraying, sleeving or welding (except MMA) techniques. Any subsequent machining shall be to the flamepath dimensions as specified in the equipment standard and/or certification documents, as appropriate. If the certification documents are not available, further guidance shall be taken from Annex C. Welding may be appropriate having due regard to the limitations of this technique (see 4.4.2.4.5).

5.3.4 Sleeve bearings

Sleeve-bearing surfaces may be reclaimed by electroplating, metal spraying or welding (except MMA) techniques.

5.3.5 Rotors and stators

If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage then the resultant increased air gap between rotor and stator should not produce, for example, a change in pressure-piling characteristics or a change in higher external surface temperatures that infringe the temperature class of the machine. If uncertainty exists with regard to possible decrimental effects, the repairer shall seek advice preferably from the manufacturer before this procedure is adopted.

Skimmed or damaged stator cores shall be submitted to a "flux test" to ensure that there are no remaining hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

5.4 Modifications

5.4.1 Enclosures

No modification affecting the explosion protection shall be carried out on parts of a flameproof enclosure without reference to the certification documentation and/or the manufacturer or, in exceptional circumstances, for example, the manufacturer discontinued trading, with the certifying authority.

5.4.2 Cable or conduit entries

Additional entries shall not be made without reference to the certification documentation and/or the manufacturer or, in exceptional circumstances, for example, the manufacturer discontinued trading, with the certifying authority.

Indirect entry, where the external conductors are connected by means of a plug and socket or within a terminal box, shall not be changed to direct entry, i.e., where the external conductors and cables are connected within the main enclosure.

5.4.3 Terminations

Termination assemblies containing a flameproof joint shall not be modified, for example, terminals with bushings between indirect-entry terminal box and main enclosure. Termination assemblies not containing a flameproof joint may be replaced by alternatives of adequate design and construction in terms of numbers, current-carrying capacity, creepage and clearance distances, and quality.

5.4.4 Windings

If equipment is to be rewound for another voltage, reference shall be made to the manufacturer. In such cases it shall be ensured that, for example, the magnetic loading, current densities, losses are not increased, appropriate new creepage and clearance distances are observed and the new voltage is within the limits of the certification documents. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed shall not be carried out without reference to the manufacturer, since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits imposed by the assigned temperature class.

5.4.5 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and the procedure for the proposed addition.

6 Additional requirements for the repair and overhaul of equipment with type of protection "i" (intrinsic safety)

6.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "i". It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an item of Ex "i" equipment are those to which the equipment was originally manufactured.

NOTE Intrinsically safe equipment may have one of three levels of protection, Exia, Exib and Exic. However, the requirements for repair and overhaul apply to all levels of protection regardless of the hazardous area (i.e. zone 0, zone 1 or zone 2), in which the equipment is installed. Furthermore, the safety of intrinsically safe systems depends upon all pieces of equipment of which they are formed, and upon the interconnecting wiring. The same consideration should be given to those parts of the system which are installed in the non-hazardous area and in the hazardous area.

6.2 Repair and overhaul

6.2.1 Enclosures

Enclosures of intrinsically safe equipment and associated apparatus are only required where intrinsic safety is dependent upon them. They are, however, often required for other reasons. Therefore, if the equipment has an enclosure, repair and overhaul activities should not reduce the protection offered by the enclosure (i.e. its IP rating).

6.2.2 Cable entries

Special entries are used to maintain the degree of ingress protection of the enclosure. Any repairs shall not result in reduction in the degree of ingress protection.

6.2.3 Terminations

When refurbishing terminal compartments, any terminals replaced shall normally be of the same type that they replace. Where the same type is not available, any alternative type used shall satisfy the creepage (according to CTI) and clearance requirements specified in the standard for the maximum voltage of the equipment and the separation required by the standard to avoid inadvertent cross-connection.

6.2.4 Soldered connections

When it is necessary to carry out repairs which require soldering techniques to be used, care shall be taken to ensure that the basis of certification is not invalidated; e.g.,

- different requirements of redundancy apply to the connection depending on whether machine or hand soldering is used;
- different requirements for creepage distances apply dependent on whether the soldered joint is sweated and coated or not.

6.2.5 Fuses

Fuses shall normally be replaced in any circumstance either with a replacement of identical type or, if this is not possible, with an alternative which has

- the same rating or less;
- the same prospective current rating or more at the same or greater voltage;
- the same type of construction;
- the same physical size.

Where this is not possible, an evaluation of the effects of the chosen fuse on intrinsic safety shall be carried out by a person fully cognizant with the requirements of the standard to which the equipment was originally manufactured and shall be fully documented.

6.2.6 Relays

If a relay is faulty, it shall be replaced by one which is identical.

6.2.7 Shunt diode safety barriers

These devices are totally encapsulated and no repair shall be attempted Where a barrier device is replaced, the replacement shall always have the same safety description and the value chosen for U_m shall be equal to, or greater than, the U_m of the original barrier Care shall also be taken that differing physical construction does not destroy the 50 mm separation required between the intrinsically safe circuits and non-intrinsically safe circuits.

6.2.8 Printed circuit boards

These parts of the equipment often have critical distances between conducting tracks (creepage distances) which shall not be reduced. Therefore, when components are replaced, care shall be taken in positioning them on the board. Where varnish is damaged during repair, insulating varnish of the type prescribed by the manufacturer shall be applied in the approved manner, for example, one coat if using dipping, two coats using other methods.

6.2.9 Optocouplers

Only components of the same or directly equivalent type and certification shall be used as replacements.

6.2.10 Electrical components

When replacing components such as resistors, transistors, zener diodes, etc., these may normally be replaced with items purchased from any source which are identical replacements In exceptional circumstances, however, some manufacturers use a "select on test" procedure for some components. Where this is done, the documentation supplied with the equipment shall indicate that either replacements be obtained from the equipment manufacturer or selected by the method he recommends.

6.2.11 Batteries

Only those types specified in the equipment manufacturer's instructions shall be used as replacements. Where batteries are encapsulated, the whole assembly shall be replaced

6.2.12 Internal wiring

Certain distances between conductors and their segregation are critical Therefore, if disturbed, internal wiring shall be re-located in its original position If insulation, screens, outer sheaths, and/or double insulation of wiring or the method of fixing are damaged, they shall be replaced by equivalent material and/or re-fixed in the same configuration

6.2.13 Transformers

If a transformer is found to be faulty, the replacement shall be obtained from the equipment manufacturer. No attempt shall be made to repair or replace any embedded (encapsulated) thermal trip device.

6.2.14 Encapsulated components

Encapsulated components, for example, batteries with internal current-limiting resistors or fuse-zener diode assemblies, are non-repairable and shall be replaced only with assemblies of the original design from the equipment manufacturer

6.2.15 Non-electrical parts

Where the equipment has non-electrical parts, for example, fittings or window, that do not affect the electrical circuit or creepage and clearance distances and hence the intrinsic safety, these parts may be replaced by new parts of equivalent type.

6.2.16 Testing

Before equipment containing intrinsically safe circuits only is re-installed in the hazardous area, then after completion of the repair or overhaul the insulation between the intrinsically safe circuit and the enclosure shall be checked by applying a 500 V a.c. to 50 Hz to 60 Hz voltage between the terminals and the enclosure for 1 min. This test can be omitted if the enclosure is of insulating material or if one side of the circuit is galvanically connected to the enclosure for safety reasons.

6.3 Reclamation

No attempt shall be made to reclaim components on which intrinsic safety depends.

6.4 Modifications

Modifications which may affect the intrinsic safety of the equipment shall not be carried out without reference to the manufacturer and/or the certification authority.

After modification, the equipment shall be assessed to ensure that it complies with the intrinsically safe system documentation before it is returned to service. It is recommended that this assessment be carried out by a person other than the one who carried out the modification.

7 Additional requirements for the repair and overhaul of equipment with type of protection "p" (pressurized)

7.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "p". It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an Ex "p" equipment are those to which the equipment was originally manufactured (see IEC 60079-2).

7.2 Repair and overhaul

7.2.1 Enclosures

While it is preferable to obtain new parts from the manufacturer, in principle a damaged part may be repaired or replaced with another given that, when compared with the original, it

- is of at least equivalent strength;
- does not result in a greater leakage rate of protective gas;
- does not restrict the flow of protective gas into or through the enclosure;
- is not shaped or fitted so as to permit the explosive atmosphere to enter the enclosure;

- is not of a construction which would result in stagnant volumes of atmosphere inside the enclosure;
- does not reduce the rate of heat dissipation from the enclosure or its content, so that it no longer complies with its temperature class

Gaskets or other sealing devices shall be replaced with others of the same material. However, a different gasket material may be used provided that it is suitable for its purpose and is compatible with the environment.

7.2.2 Cable and conduit entries

Entries shall preserve the degree of ingress protection originally provided and shall not allow increased leakage of pressurizing gas.

7.2.3 Terminations

The preservation of creepage and clearance distances as originally provided shall be ensured.

7.2.4 Insulation

Any replacement insulation used in the course of repair or overhaul shall be at least of the quality and class of that originally employed (see IEC 60085).

7.2.5 Internal connections

Internal connections shall not be electrically, thermally or mechanically inferior to those originally fitted and shall be of a standard at least equivalent to that of the original design.

7.2.6 Windings

7.2.6.1 General

The original winding data shall preferably be obtained from the manufacturer. If this is not possible, then use may be made of copy winding techniques. The materials used in rewinding shall comprise an appropriate insulation system. If superior insulation is proposed compared to that of the original, the rating of the winding shall not be increased without reference to the manufacturer, as the temperature classification of the equipment could then be adversely affected.

7.2.6.2 Repair of rotating machine rotors

Faulty die-cast aluminium rotor cages shall be replaced by new rotors obtained from the manufacturer or his distributor. Bar-wound cage rotors shall be rewound using materials of similar or improved specification. Particular care is necessary to ensure that, when replacing conductors in a cage rotor, such conductors are tight in the slots. The method of achieving tightness employed by the manufacturer shall be adopted.

7.2.6.3 Testing after repair of windings

7.2.6.3.1 General

Windings, after complete or partial repair, shall be subjected, with the equipment assembled, to the following tests, as far as reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. In the case of three-phase windings, the resistance of each phase or between line terminals shall be balanced as far as is reasonable, unbalance of less than 5 % of middle value being acceptable.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. A minimum test voltage of 500 V d.c. is recommended. Minimum acceptable insulation resistance values are a function of rated voltage, temperature, type of equipment and whether the rewind is partial or complete.

NOTE The insulation resistance should not be less than 20 MΩ at 20 °C on a completely rewound equipment intended for use up to 690 V.

c) A high-voltage test, in accordance with a relevant equipment standard, shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.

d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value shall be compared with that derived from the manufacturer's data, where available, and in three-phase systems shall be balanced in all phases, as far as is reasonable.

e) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair or overhaul contract.

7.2.6.3.2 Rotating machines

Rotating machines, in addition to the above tests, shall be subjected to the following tests, as far as is reasonably practicable.

a) The machine shall be run at full speed and the cause of any untoward noise and/or mechanical vibration investigated and corrected.

b) The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75 % and 125 % of full-load current and to ensure balance on all phases. (The test, which in some respects is an alternative to a full-load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.) Unbalance of less than 5 % of the middle value is acceptable.

c) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE Guidance on test voltages and additional tests for rotating machines is given in IEC 60034.

7.2.7 Light-transmitting parts

Light-transmitting parts made from plastics shall not be cleaned with solvent. Household detergents are recommended for this purpose.

7.2.8 Encapsulated parts

In general, encapsulated parts (for example, switching devices in luminaires) are not considered suitable for repair.

7.2.9 Batteries

Where batteries are used, the manufacturer's advice shall be followed.

7.2.10 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

7.2.11 Lampholders

Replacements listed by the manufacturer shall be used.

7.2.12 Ballasts

Chokes or capacitors shall be replaced only by manufacturer's listed parts, unless reference is made to the manufacturer to determine if alternatives may be used.

7.3 Reclamation

Reclamation using the techniques detailed in Clause 4 may be used with type of protection "p" equipment subject to the following restrictions of this clause.

7.3.1 Enclosures

7.3.1.1 General

If damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care shall be taken to ensure that the integrity of the equipment is not significantly impaired so as to degrade the type of protection, in particular, that it remains capable of withstanding the impact test and the appropriate level of overpressure.

7.3.1.2 Joints

If damaged or corroded joint faces are to be machined, the mechanical strength and operation of the component shall not be impaired nor the degree of ingress protection affected.

Spigoted joints are normally provided to achieve close tolerance location. Thus, machining the male part will require addition of metal to, and the machining of, the female part (or vice versa) to retain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal shall be by electroplating, sleeving or welding but metal spraying techniques which have a bond strength less than 40 MPa are not recommended.

7.3.2 Shafts and housings

If shafts and bearing housings are to be reclaimed, this shall be carried out by the use of metal spraying or sleeving techniques. Welding may be appropriate with due regard to the limitations of this technique (see 4.4.2.4.5).

7.3.3 Sleeve bearings

Sleeve-bearing surfaces may be reclaimed by electroplating, metal spraying or welding (except MMA) techniques.

7.3.4 Rotors and stators

If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage after consultation with the manufacturer, the resultant increased air gap between rotor and stator shall not produce higher external surface temperatures that infringe the temperature class of the machine.

Skimmed or damaged stator cores shall be subjected to a "flux test" to ensure that there are no remaining hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

7.4 Modifications

7.4.1 Enclosures

Enclosures not containing a source of release of flammable gas may be modified. Any modified part shall meet the conditions given in 7.2.

Enclosures with an internal source of release of flammable gas such as analysers, chromatographs, etc. shall not be modified in any way whatsoever without reference to the manufacturer.

The point(s) at which the level of overpressure and the rate of flow or purging gas is (are) monitored shall not be altered nor should the setting of any timer or other monitoring devices be changed.

7.4.2 Cable and conduit entries

Special care shall be taken to ensure that if alteration is made to entries, the specified type of protection and degree of ingress protection are maintained.

7.4.3 Terminations

Modification of terminations shall be made using good engineering practices.

7.4.4 Windings

Rewinding of the equipment for another voltage shall be carried out only after reference to the manufacturer provided that, for example, the magnetic loading, current densities and losses are not increased, appropriate new creepage and clearance distances are observed and the new voltage is within the limits of the certification documents. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed shall not be carried out without reference to the manufacturer, since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits imposed by the assigned temperature class if appropriate, and the efficacy of the pressurizing system could be jeopardized

7.4.5 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and the procedure for the proposed addition.

8 Additional requirements for the repair and overhaul of equipment with type of protection "e" (increased safety)

8.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "e". It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant The relevant equipment standards which shall be referred to when repairing or overhauling Ex "e" equipment are those to which the equipment was originally manufactured (see IEC 60079-7).

8.2 Repair and overhaul

8.2.1 Enclosures

While it is preferable to obtain new parts from the manufacturer, in principle, damaged parts may be repaired or replaced with others, given that the degree of ingress protection and temperature classification as stipulated on the certification label are preserved

A more stringent degree of ingress protection than that specified in the equipment standard may have been provided to cater for environmental conditions in which case any repair shall not jeopardize such higher degree of ingress protection.

Particular attention is drawn to impact test requirements of all parts of the enclosure and also the degree of ingress protection to be provided for air inlet and outlet openings, as given in the equipment standard.

Adequate clearance shall be maintained between stationary and rotating parts in accordance with the equipment standard. Adequate clearance shall mean the clearance required by the manufactuer's certified drawings or in the absence of drawings, minimum clearance as specified in IEC 60079-7.

Attention is drawn to the effects of surface finishes, paint, etc. on the temperature classification of enclosures. Only finishes specified by the manufacturer shall be applied

Before a rewound or repaired rotating machine is put back into service, it is essential to ensure that any fan cover ventilation holes are not blocked or so damaged as to impair the passage of cooling air over the machine and that fan clearances are in compliance with the certification requirements. Should a fan or fan cover be so damaged as to require renewal, the replacement parts shall be obtained from the manufacturer. If unobtainable, they shall be of the same dimensions and at least of the same quality as the original parts. They shall, where appropriate, take account of the requirements of the equipment standard to avoid frictional sparking and electrostatic charging and of the chemical environment in which the machine is used.

8.2.2 Cable or conduit entries

Entries shall preserve a minimum IP54 degree of ingress protection, in accordance with the requirements of IEC 60529, and at least the same IP rating as the equipment was originally designed for.

8.2.3 Terminations

The design of terminations in terms of the materials and construction used, the creepage and clearance distances and the comparative tracking indices of termination insulation will normally be fully specified in the certification documents. Replacement parts shall be obtained from the manufacturer or his advice sought regarding acceptable alternatives.

Where terminations are loose leads, the methods of termination including insulation shall be in accordance with the certification documents.

8.2.4 Insulation

Comprehensive details of the insulation system of windings, including the type of impregnation varnish, are normally included in the certification documents. Where this does not apply, full information shall be sought from the manufacturer.

8.2.5 Internal connections

If internal connections are to be renewed, the insulation on such connections shall not be electrically, thermally or mechanically inferior to that originally supplied.

The cross-sectional area of any replacement connection shall not be less than that originally fitted. The permitted methods of connecting conductors are given in the relevant standards.

8.2.6 Windings

8.2.6.1 General

The electrical construction of type of protection "e" equipment decisively influences the explosion safety and the repairer shall be in full possession of the necessary information and equipment.

Unless the repairer can meet all the requirements of the equipment standard, rewinding shall be carried out by the original manufacturer. For HV windings, the additional requirements for insulation as defined in the equipment standard shall be followed.

Before the repair, the original winding data, which should generally be available from the manufacturer, should be obtained, i.e.:

a) type of winding – for example, single-layer, double-layer, etc.;

b) winding diagram;

c) number of conductors/slot, parallel paths per phase;

d) interphase connections;

e) conductor size;

f) insulation system, including varnish specification;

g) resistance/phase or between terminals.

Where the original insulation system and/or varnish system is not available, the t_E time shall be verified in accordance with the equipment standard.

Copy winding techniques are not permisible unless the t_E time is verified in accordance with the equipment standard. The whole of the winding shall be restored to the original condition except that a partial winding replacement may be possible on larger equipment where this may be practicable, but only if reference has been made to the manufacturer or certifying authority.

8.2.6.2 Repair of rotating machine rotors

Rotors with faulty die-cast aluminium cages shall be replaced by completely new rotors obtained from the manufacturer or his distributor.

Bar-wound cage rotors shall be rewound using materials of identical specifications. Particular care is necessary to ensure that if replacing conductors in a cage rotor such conductors are tight in the slots and that slots have not been damaged. The method of achieving tightness employed by the manufacturer shall be adopted.

8.2.6.3 Testing after repair of windings

8.2.6.3.1 General

After complete or partial repair, windings shall be subjected, with the equipment assembled, to the following tests so far as is reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. In the case of three-phase windings, the resistance of each phase or between line terminals should be balanced, as far as is reasonable, unbalance of less than 5 % of the middle value being acceptable.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. The minimum test voltage of 500 V d.c. is recommended. Minimum acceptable insulation resistance values are a function of rated voltage, temperature and type of equipment and whether the rewind is partial or complete.

   NOTE The insulation resistance should not be less than 20 MΩ at 20 °C on a completely rewound equipment intended for use up to 690 V.

c) A high-voltage test, in accordance with a relevant equipment standard, shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.

d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value shall be compared with that derived from the manufacturer's data, where available, and in three-phase systems should be balanced in all phases, as far as is reasonable.

e) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair or overhaul contract.

8.2.6.3.2 Rotating machines

In addition to the above tests, rotating machines shall be subjected to the following tests so far as is reasonably practicable.

a) The machine shall be run at full speed and the cause of any untoward noise and/or mechanical vibration investigated and corrected.

b) The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75 % and 125 % of full-load current and to ensure balance on all phases. (The test, which in some respects is an alternative to a full-load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.) Unbalance of less than 5 % of the middle value is acceptable.

c) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE Guidance on test voltages and additional tests for rotating machines is given in IEC 60034.

8.2.6.3.3 Temperature sensors

If temperature sensors are included to monitor winding temperatures, it is recommended that they are embedded in the winding before varnishing and curing.

8.2.7 Light-transmitting parts

No attempt shall be made to repair light-transmitting parts and only replacement components provided by the manufacturer shall be used. Light-transmitting parts or other parts made of plastic shall not be cleaned with solvents. Household detergents may be used.

8.2.8 Encapsulated parts

In general, encapsulated parts (for example, switching devices in luminaires) are not considered suitable for repair or reclamation.

8.2.9 Batteries

Where batteries are used, reference shall be made to the manufacturer's instructions before carrying out any repair or replacement.

8.2.10 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

Special care shall be taken with single-pin tubular fluorescent tubes. The single pin, when inserted in the lampholder, forms a flameproof enclosure and distortion or misalignment may affect the designed explosion protection.

8.2.11 Lampholders

Only replacements specified by the manufacturer shall be used. In those cases where the wiring to the lampholder is factory-made (crimps, etc.), rewiring shall not be undertaken unless the repairer has the equipment to make up the wiring to the same standard.

NOTE Lampholders for type of protection "e" luminaires are invariably of specific types, either single-pin for tubular fluorescent lamps or screw for other types.

8.2.12 Ballasts

Defective chokes and capacitors shall only be replaced with the manufacturer's listed parts.

8.3 Reclamation

Reclamation using the techniques detailed in Clause 4 may be used with the type of protection "e" equipment subject to the following restrictions of this clause.

8.3.1 Enclosures

8.3.1.1 General

If minor damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care shall be taken to ensure that the integrity of the equipment is not significantly impaired as to degrade the type of protection, in particular, that it remains capable of withstanding the impact test and maintains the degree of ingress protection

8.3.1.2 Joints

If damaged or corroded joint faces are to be machined, the mechanical strength and operation of the component shall not be impaired nor the degree of ingress protection affected

Where joints are provided to achieve close tolerance location, machining the male part may require addition of metal to it and also machining of the female part (or vice versa) to retain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal shall be by electroplating, sleeving or welding, but metal spraying techniques which have a bond strength less than 40 MPa is not recommended.

8.3.1.3 Shafts and housings

If shafts and bearing housings are to be reclaimed, this may be carried out by use of metal spraying or sleeving techniques. Welding may be appropriate with due regard to the limitations of this technique (see 4.4.2.4.5).

8.3.2 Sleeve bearings

Sleeve-bearing surfaces may be reclaimed by electroplating, metal spraying or welding (except MMA) techniques.

8.3.3 Rotors and stators

If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage after consultation with the manufacturer, the resultant increased air gap between rotor and stator shall not produce

- higher internal and/or external surface temperatures that infringe the temperature class of the machine, or
- changes in electrical/mechanical performance which prevents the electrical/thermal protective device providing the tripping characteristics required to conform to the equipment standard.

Skimmed or damaged stator cores should be subjected to a "flux test" to ensure that there are no remaining hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

8.4 Modifications

8.4.1 Enclosures

Enclosures may be modified provided that the specified temperature classification, degree of ingress protection and impact test requirements of the appropriate standards are met.

8.4.2 Cable and conduit entries

Special care shall be taken to ensure that if alteration is made to entries, the specified type of protection and degree of ingress protection are maintained.

8.4.3 Terminations

No modification of terminations shall be made without reference to the manufacturer.

8.4.4 Windings

Rewinding of the equipment for another voltage shall be carried out only after reference to the manufacturer and provided that, for example, the magnetic loading, current densities and losses are not increased, new appropriate creepage and clearance distances are observed, and the new voltage, t_E time and I_A/I_N ratio are within the limits of the certification documents. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed shall not be carried out without reference to the manufacturer, since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits of the certification documents.

8.4.5 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and the procedure for the proposed modification.

9 Additional requirements for the repair and overhaul of equipment with type of protection "n" (non-sparking)

9.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "n". It shall be read in conjunction with Clause 4 which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an Ex "n" equipment are those to which the equipment was originally manufactured (see IEC 60079-15).

9.2 Repair and overhaul

9.2.1 Enclosures

Whilst it is preferable to obtain new parts from the manufacturer, in principle, damaged parts may be repaired or replaced with others, given that the degree of ingress protection and temperature classification as stipulated on the certification label is preserved.

A more stringent degree of ingress protection than that specified in the equipment standard may have been provided to cater for environmental conditions, in which case any repair shall not jeopardize such higher degree of ingress protection

Particular attention is drawn to the impact test requirements of all parts of the enclosure as given in the equipment standard.

Adequate clearance shall be maintained between stationary and rotating parts in accordance with the equipment standard.

Restricted breathing enclosures depend for their explosion protection on gaskets and other means of sealing. Particular attention should be paid to the condition of the sealing arrangements to preserve the type of protection.

Attention is drawn to the effect of surface finish, paint, etc. on the temperature classification of enclosures. Only finishes specified by the manufacturer should be applied.

Before a rewound or repaired rotating machine is put back into service, it is essential to ensure that any fan cover ventilation holes are not blocked or so damaged as to impair the passage of cooling air over the machine and that fan clearances are in compliance with the certification requirements. Should a fan or fan cover be so damaged as to require renewal, the replacement parts shall be obtained from the manufacturer. If unobtainable then they shall be of the same dimensions and at least of the same quality as the original parts They shall, where appropriate, take account of the requirement of the standard to avoid frictional sparking or electrostatic charging, and of the chemical environment in which the machine is used

9.2.2 Cable and conduit entries

Entries shall preserve a minimum IP54 degree of protection in accordance with the requirements of IEC 60529

9.2.3 Terminations

Care shall be taken when refurbishing terminal compartments to maintain clearances and creepages in accordance with the equipment standard Where non-metallic screws are used for fixing, only replacement screws of similar materials shall be used

Where terminations are loose leads, the method of termination including insulation shall be in accordance with the certification documents.

9.2.4 Insulation

A class of insulation the same as or superior to that originally provided shall be employed. for example, a winding insulated with class E material may be repaired using class F material (see IEC 60085).

9.2.5 Internal connections

If internal connections are to be renewed, the insulation on such connections shall not be electrically, thermally or mechanically inferior to that originally supplied

The cross-sectional area of any replacement connection shall not be less than that originally fitted.

9.2.6 Windings

9.2.6.1 General

Where rewinding is carried out, it is essential that the original winding data are determined and that the new winding conforms to the original. If superior insulation is proposed compared to that of the original, the rating of the winding shall not be increased without reference to the manufacturer, as the temperature classification of the equipment could then be adversely affected.

The original winding data should preferably be obtained from the manufacturer. If this is not reasonably practicable then use may be made of copy winding techniques.

It is not recommended to have a partial winding replacement, except on a larger equipment where this may be practicable, unless reference has been made to the manufacturer or certifying authority.

9.2.6.2 Repair of rotating machine rotors

A faulty die-cast aluminium rotor shall be replaced by a complete new rotor obtained from the manufacturer or his distributor.

Bar-wound cage rotors shall be rewound using materials of similar or improved specification. Particular care is necessary to ensure that if replacing conductors in a cage rotor, such conductors are tight in the slots. The method of achieving tightness employed by the manufacturer shall be adopted.

9.2.6.3 Testing after repair of windings

9.2.6.3.1 General

Windings, after complete or partial repair, shall be subjected, with the equipment assembled, to the following tests as far as is reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. In the case of three-phase windings, the resistance of each phase or between line terminals shall be balanced, as far as is reasonable.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. A minimum test voltage of 500 V d.c. is recommended.

   Minimum acceptable insulation resistance values are a function of rated voltage, temperature, type of equipment and whether the rewind is partial or complete.

   NOTE The insulation resistance should not be less than 20 MΩ at 20 °C, on a completely rewound equipment intended for use at up to 690 V.

c) A high-voltage test in accordance with a relevant equipment standard shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.

d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value should be compared with that derived from the manufacturer's data, where available, and in three-phase systems shall be balanced in all phases, as far as is reasonable.

e) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair and overhaul contract.

9.2.6.3.2 Rotating machines

Rotating machines, in addition to the above tests, shall be subjected to the following tests so far as is reasonably practicable.

a) The machine shall be run at full speed and the cause of any untoward noise and/or mechanical vibration investigated and corrected.

b) The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75 % and 125 % of full-load rated current and to ensure balance on all phases. (The test, which, in some respects, is an alternative to a full-load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.)

c) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE Guidance on test voltage and additional tests for rotating machines is given in IEC 60034.

9.2.6.4 Temperature sensors

If temperature sensors are included to monitor winding temperatures, it is recommended that they are embedded in the winding before varnishing and curing.

9.2.7 Light-transmitting parts

Light-transmitting or other parts made of plastic shall not be cleaned with solvents. Household detergents may be used.

9.2.8 Encapsulated parts

In general, encapsulated parts, for example, switching devices in luminaires, are not considered suitable for repair.

9.2.9 Batteries

Where batteries are used, reference shall be made to the manufacturer's instructions before carrying out any repair or replacement.

9.2.10 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

9.2.11 Lamp holders

Replacements listed by the manufacturer shall be used.

9.2.12 Ballasts

Chokes or capacitors shall only be replaced with manufacturer's listed parts. If these are of proprietary manufacture, reference shall be made to the original manufacturer to determine if alternatives may be used.

9.2.13 Enclosed break devices

In general, enclosed break devices are not considered to be suitable for repair. Replacement parts listed by the manufacturer shall be used.

9.3 Reclamation

Reclamations using the techniques detailed in 4.4.2.4 may be used with type of protection "n" equipment subject to the following restrictions of this subclause.

9.3.1 Enclosures

If minor damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care shall be taken to ensure that the integrity of the equipment is not impaired, in particular, that it remains capable of withstanding the impact test and maintains the degree of ingress protection.

9.3.2 Joints

If damaged or corroded faces are to be machined, the mechanical strength and operation of the component shall not be impaired nor the degree of ingress protection affected.

Spigoted joints are normally provided to achieve close tolerance location. Thus, machining the male part will require addition of metal to and machining of the female part (or vice versa) to retain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal shall be by electroplating, sleeving or welding, but metal spraying is not recommended

9.3.3 Rotating machines

9.3.3.1 Shafts and housings

Shafts and bearing housings may be reclaimed, preferably by use of metal spraying or sleeving techniques. Welding may be appropriate having due regard to the limitations of this technique (see 4 4 2 4)

9.3.3.2 Sleeve bearings

Sleeve-bearing surfaces may be built up by electroplating, metal spraying or welding (except MMA) techniques

9.3.3.3 Rotors and stators

If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage, the resultant increased air gap between rotor and stator shall not produce higher internal or external surface temperatures that infringe the temperature class of the machine.

Skimmed or damaged stator cores shall be subjected to a "flux test" to ensure that there are no remaining hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

9.4 Modifications

9.4.1 Enclosures

Enclosures may be modified provided that the specified temperature classification, degree of ingress protection and impact test requirements of the appropriate standard are met

9.4.2 Cable and conduit entries

Care shall be taken to ensure that the specified type of protection and degree of ingress protection are maintained.

9.4.3 Terminations

Terminations shall be modified only if compliance with the equipment standard is maintained.

9.4.4 Windings

It is permissible to rewind the equipment for another voltage after reference to the manufacturer provided that, for example, the magnetic loading, current densities and losses are not increased, appropriate new clearances and creepage distances are observed and the new voltage is within the limits of the certificate. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed is not permissible without reference to the manufacturer since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits of the certification documents

9.4.5 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and procedure for the proposed modification.

10 Additional requirements for the repair and overhaul of equipment covered by IEC 60079-26

No repair or overhaul shall be carried out without availability of manufacturer information. In addition to meeting the requirements of IEC 60079-26, the applicable requirements of Clauses 5 to 8 of this standard still apply.

If the certification documents are not available, the equipment shall be subjected to re-testing in accordance with the appropriate equipment standard.

11 Additional requirements for the repair and overhaul of equipment with type of protection 'tD'

11.1 Application

This clause contains additional requirements for the repair, overhaul, reclamation and modification of equipment with type of protection "tD" (formerly known as DIP). It shall be read in conjunction with Clause 4, which contains general requirements, and any other appropriate clauses if relevant. The relevant equipment standards which shall be referred to when repairing or overhauling an Ex "tD" equipment are those to which the equipment was originally manufactured.

NOTE The highest temperature which is attained by any part of the external surface of electrical equipment when tested under the defined dust-free or dust-layer conditions at the specified maximum ambient temperature (normally 40 °C) is marked on the equipment as a temperature value *T*. Practice A equipment with the zone prefixed "A" had been type-tested under dust-free conditions. Practice B equipment with the zone prefixed "B" had been type-tested under dust-layer conditions.

11.2 Repair and overhaul

11.2.1 Enclosures

Whilst it is preferable to obtain new parts from the manufacturer, in principle, damaged parts may be repaired or replaced with others, given that the degree of ingress protection and temperature classification as stipulated on the certification label is preserved.

If visual inspection (for example, ingress of dust or water) indicates that the effectiveness of sealing elements of the enclosure suffered from damage or ageing, such elements shall be replaced, preferably by using original spare parts supplied by the equipment manufacturer or by gasket parts of equivalent quality.

If there are any signs that the specified temperature has been exceeded, or, in case of doubt, actual measurements according to IEC 61241-0 shall be made. If necessary, active parts such as windings, cores, cooling systems shall be replaced using manufacturer's spare parts and/or advice.

A more stringent degree of ingress protection than that specified in the equipment standard may have been provided to cater for environmental conditions, in which case any repair shall not jeopardize such higher degree of ingress protection.

Particular attention is drawn to the impact test requirements of all parts of the enclosure as given in the equipment standard.

Adequate clearance shall be maintained between stationary and rotating parts in accordance with the equipment standard.

Attention is drawn to the effect of surface finish, paint, etc. on the temperature classification of enclosures. Only finishes specified by the manufacturer or equivalent should be applied.

Before a rewound or repaired rotating machine is put back into service, it is essential to ensure that any fan-cover ventilation holes are not blocked or so damaged as to impair the passage of cooling air over the machine and that fan clearances have minimum values as specified in IEC 61241-0, to avoid mechanical sparking. Should a fan, fan-cowl or air-inlet screen be so damaged as to require renewal, the replacement parts shall be obtained from the manufacturer. If unobtainable, then they shall be of the same dimensions and at least of the same quality as the original parts. They shall, where appropriate, take account of the requirement of the standard to avoid frictional sparking or electrostatic charging and of the chemical environment in which the machine is used.

Plastic material for enclosures, parts of enclosures or parts of the external ventilation system of rotating electrical machines are designed so that the danger of ignition due to propagating brush discharges is avoided. Spare parts, in addition to dimensional compliance, shall have the electrostatic discharge properties as specified in IEC 61241-0.

11.2.2 Cable and conduit entries

Entries shall preserve a minimum IP5X or IP6X degree of ingress protection as appropriate in accordance with the requirements of IEC 60529.

11.2.3 Insulation

A superior class of insulation compared with that originally used does not permit an increase in equipment rating without reference to the manufacturer.

11.2.4 Internal connections

The cross-sectional area of any replacement connection shall not be less than that originally fitted.

11.2.5 Windings

11.2.5.1 General

Where rewinding is carried out, it is essential that the original winding data are determined and that the new winding conforms to the original. If superior insulation is proposed compared to that of the original, the rating of the winding shall not be increased without reference to the manufacturer, as the temperature classification of the equipment could then be adversely affected.

The original winding data should preferably be obtained from the manufacturer. If this is not reasonably practicable, then use may be made of copy winding techniques.

It is not recommended to have a partial winding replacement, except on a larger equipment where this may be practicable, unless reference has been made to the manufacturer or certifying authority.

11.2.5.2 Testing after repair of windings

11.2.5.2.1 General

Windings, after complete or partial repair, shall be subjected, with the equipment assembled, to the following tests as far as is reasonably practicable.

a) The resistance of each winding shall be measured at room temperature and verified. In the case of three-phase windings, the resistance of each phase or between line terminals shall be balanced, as far as is reasonable; unbalance less than 5 % of middle value is acceptable.

b) An insulation resistance test shall be applied to measure the resistance between the windings and earth, between windings where possible, between windings and auxiliaries, and between auxiliaries and earth. A minimum test voltage of 500 V d.c. is recommended.

   Minimum acceptable insulation resistance values are a function of rated voltage, temperature, type of equipment and whether the rewind is partial or complete

   NOTE The insulation resistance should not be less than 20 MΩ at 20 °C, on a completely rewound equipment intended for use at up to 690 V.

c) A high-voltage test in accordance with a relevant equipment standard shall be applied between windings and earth, between windings where possible, and between windings and auxiliaries attached to the windings.

d) The transformer or similar equipment shall preferably be energized at rated supply voltage. The supply current, secondary voltage and current shall be measured. The measured value should be compared with that derived from the manufacturer's data, where available, and in three-phase systems shall be balanced in all phases, as far as is reasonable.

e) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and other special equipment may require additional tests. This shall be the subject of the repair and overhaul contract.

11.2.5.2.2 Rotating machines

Rotating machines, in addition to the above tests, shall be subjected to the following tests so far as is reasonably practicable.

a) The machine shall be run at full speed and the cause of any untoward noise and/or mechanical vibration investigated and corrected.

b) The stator windings of cage machines shall be energized at an appropriate reduced voltage, with the rotor locked, to obtain between 75 % and 125 % of full-load rated current and to ensure balance on all phases. (The test, which in some respects is an alternative to a full load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.)

c) High-voltage (for example, 1 000 V a.c./1 500 V d.c. and above) and non-cage machines may require alternative and/or additional tests. This shall be the subject of the repair or overhaul contract.

NOTE Guidance on test voltage and additional tests for rotating machines is given in IEC 60034.

11.2.6 Temperature sensors

If temperature sensors are included to monitor winding temperatures, it is recommended that they are embedded in the winding before varnishing and curing.

11.2.7 Light-transmitting parts

Light-transmitting or other parts made of plastic shall not be cleaned with solvents. Household detergents may be used.

11.2.8 Lamps

Lamp types specified by the manufacturer shall be used as replacements and the maximum wattage specified shall not be exceeded.

11.3 Reclamation

Reclamations using the techniques detailed in 4.4.2.4 may be used with type of protection "tD" equipment subject to the following restrictions of this subclause.

11.3.1 Enclosures

If minor damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care shall be taken to ensure that the integrity of the equipment is not impaired, in particular, that it remains capable of withstanding the impact test and maintains the degree of ingress protection.

11.3.2 Joints

If damaged or corroded faces are to be machined, the mechanical strength and operation of the component shall not be impaired nor the degree of ingress protection affected.

Spigoted joints are normally provided to achieve close tolerance location. Thus, machining the male part will require addition of metal to, and machining of, the female part (or vice versa) to retain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining. The addition of metal shall be by electroplating, sleeving or welding, but metal spraying techniques which have a bond strength less than 40 MPa is not recommended.

11.3.3 Rotating machines

11.3.3.1 Shafts and housings

Shafts and bearing housings may be reclaimed, preferably by use of metal spraying or sleeving techniques. Welding (except MMA) may be appropriate having due regard to the limitations of this technique (see 4.4.2.4).

11.3.3.2 Sleeve bearings

Sleeve-bearing surfaces may be built up by electroplating, metal spraying or welding (except MMA) techniques.

11.3.3.3 Rotors and stators

If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage, the resultant increased air gap between rotor and stator shall not produce higher external surface temperatures that infringe the temperature class of the machine.

Skimmed or damaged stator cores shall be subjected to a "flux test" to ensure that there are no remaining hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

11.4 Modifications

11.4.1 Enclosures

Enclosures may be modified provided that the specified temperature classification, degree of ingress protection and impact test requirements of the appropriate standard are met.

11.4.2 Cable and conduit entries

Care shall be taken to ensure that the specified type of protection and degree of ingress protection are maintained.

11.4.3 Windings

It is permissible to rewind the equipment for another voltage after reference to the manufacturer provided that, for example, the magnetic loading, current densities and losses are not increased, appropriate new clearances and creepage distances are observed and the new voltage is within the limits of the certificate. The rating plate shall be changed to show the new parameters.

Rewinding a rotating machine for a different speed is not permissible without reference to the manufacturer since the electrical and thermal characteristics of the machine could be significantly altered to the point of being outside the limits of the certification documents.

11.4.4 Auxiliary equipment

In cases where additional auxiliary equipment is requested, for example, anti-condensation heaters or temperature sensors, the manufacturer shall be consulted to establish the feasibility of and procedure for the proposed modification.

12 Additional requirements for the repair and overhaul of equipment with type of protection pressurization "pD"

12.1 Application

Equipment used within enclosures that are certified as complying with the requirements of IEC 61241-2 is generally unspecified with respect to that standard. Variations can therefore be made to include equipment without invalidating the certificate. However, there are general restrictions such as electrical performance and temperature rating that are taken into consideration if changes to internal equipment are made.

NOTE In contrast to type of protection "p" purging is not allowed with type of protection "pD". Internal cleaning of the enclosure is necessary before the electrical supply can be connected as per IEC 61241-2.

12.2 Repair and overhaul

The requirements for repair and overhaul are identical with those of protection "p" as specified in Clause 7.

12.3 Reclamation

The requirements for reclamations are identical with those of protection "p" as specified in Clause 7.

12.4 Modifications

The requirements for modifications are identical with those of protection "p" as specified in Clause 7.

Annex A
(normative)

Identification of repaired equipment by marking

A.1 Marking information

Repaired and overhauled equipment shall be marked on the main part in a visible place. This marking shall be legible and durable taking into account all relevant environmental conditions. The marking shall include

- the relevant symbol (see Clause A.2 below);
- the standard number "IEC 60079-19" or national equivalent;
- the name of the repairer or his registered trade mark and workshop certification, if any;
- the repairer's reference number relating to the repair;
- the date of the overhaul/repair.

The marking may be on a plate permanently attached to the repaired equipment.

In the event of subsequent repairs, the earlier repair/overhaul plate shall be removed, a record being made of all the markings on it.

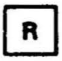
If an earlier plate has been removed and it had the triangular symbol as shown in A.2.2, then the symbol on subsequent plates should also be triangular unless the repairer restores the whole equipment to full conformity with the certification documents.

Equipment which, after repair or overhaul, conforms neither to the certification documents nor to the explosion protection concept standard shall have all the marking details relating to the explosion protection concept standard removed with the agreement of the user.

A.2 Symbols

A.2.1 In accordance with certification and/or manufacturer's specification

This mark is to be used only when the repair or reclamation is in accordance with this standard and the repairer has sufficient evidence of full compliance with the certification documents and/or manufacturer's specification.



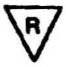
A.2.2 In accordance with standards but not the certification documents

This mark is to be used when either

a) the equipment is changed during repair or reclamation so that it still complies with the restrictions imposed by this standard and the explosion protection standards to which it was manufactured, but repairer has insufficient evidence of full compliance with the certification documents; or

b) the standards to which the previously certified equipment was manufactured are not known, but the requirements of this standard and the current edition of the relevant explosion protection standards have been applied but repairer has insufficient evidence of full compliance with the certification documents. An assessment, by a person competent in assessing explosion protected equipment has been conducted to verify compliance with the relevant level of safety prior to release of the equipment by the repairer.

In these situations the certification labels should not be removed.



NOTE These marking are required for the benefit of subsequent repairers and the only difference between the markings is the method of compliance.

A.2.3 Other situations

Equipment which, after repair or reclamation, does not conform to A.2.1 or A.2.2 should have its original manufacturer's certification label removed or altered to give a clear indication that the equipment is not certified, until a supplementary certificate is obtained to cover the repair or overhaul.

If the equipment is returned to its owner before such supplementary certification is obtained, the record described in 4.4.1.5 should indicate that the equipment is not in serviceable condition and is not to be used in a place where explosive atmosphere is likely to occur.

Annex B
(normative)

Knowledge, skills and competencies of "Responsible Persons" and "Operatives"

B.1 Scope

This annex specifies the knowledge, skills and competencies of persons referred to in this standard.

B.2 Knowledge and skills

B.2.1 Responsible Persons

"Responsible Persons" who are responsible for the processes involved in the overhaul, repair and reclamation of specific types of explosion protection of explosion protected equipment, shall possess, at least, the following:

a) general understanding of relevant electrical and mechanical engineering at the craftsperson level or above;

b) practical understanding of explosion-protection principles and techniques;

c) understanding and ability to read and assess engineering drawings;

d) familiarity with measurement functions, including practical metrology skills, to measure known quantities;

e) working knowledge and understanding of relevant standards in the explosion protection field;

f) basic knowledge of quality assurance, including the principles of traceability of measurement and instrument calibration.

Such persons shall confine their involvement to overhaul, repair and reclamation in the nominated areas of competence and not engage themselves in modifications of explosion protected equipment without expert guidance.

B.2.2 Operatives

Operatives shall possess, to the extent necessary to perform their tasks, the following:

a) understanding of the general principles of types of protection and marking;

b) understanding of those aspects of equipment design which affect the protection concept,

c) understanding of certification and relevant parts of this standard;

d) ability to identify replacement parts and components authorized by the manufacturer;

e) familiarity with the particular techniques to be employed in repairs referred to in this standard.

B.3 Competencies

B.3.1 General

Competencies shall apply to each of the explosion-protection techniques for which the person is involved. For example: it is possible for a person to be competent in the field of repair and overhaul of Ex'd' motors only and not be fully competent in repair of Ex'd' switchgear or Ex'e' motors. In such cases, the repair facility management shall define this in their documentation system.

B.3.2 Responsible persons

Responsible persons shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in B.2.1 relevant to the types of protection and/or types of equipment involved.

B.3.3 Operatives

Operatives shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in B.2.2 relevant to the types of protection and/or types of equipment involved.

They shall also be able to demonstrate their competency in the

- use and availability of documentation specified in 4.4.1.5.1;
- production of job reports to the user as specified in 4.4.1.5.2;
- use and production of repair facility records as specified in 4.4.1.5.3.

B.4 Assessment

The competency of responsible persons and operatives shall be verified and attributed, at intervals in accordance with 4.4.1.3 and 4.4.2.3, on the basis of sufficient evidence that the person

a) has the necessary skills required for the scope of work;

b) can act competently across the specified range of activities; and

c) has the relevant knowledge and understanding underpinning competency.

Annex C

(normative)

Requirements for measurements in flameproof equipment during overhaul, repair and reclamation (including guidance on tolerances)

C.1 General

Evidence has come to light that there have been instances where equipment passed the Ex d flame transmission test with the gaps set to the maximum specified by the manufacturer but failed the test when set to the larger gaps permitted by the Ex d standard. As such equipment has not necessarily been marked with an 'X' on the certificate, there is no way of knowing whether the equipment can be safely repaired to the values allowed by the standard or whether it needs to be repaired to the smaller gaps specified by the manufacturer. Therefore, in the absence of drawings showing the manufacturer's gaps, repairers should use the guidance given in Table C.1.

NOTE Figure C.1 is equivalent to Table C.1.

Table C.1 – Determination of maximum gap of reclaimed parts

Ref.	Condition			Maximum gap
1.	Dimensions are available on the certified documentation.			Use the values specified in that documentation.
2.	Original national standard [a] required that the test gap be set at the value in that standard.			Use the values specified in the standard used.
3a	Original standard requires that suffix 'X' is marked where the test gap is less than the values in that standard.	Certificate has suffix 'X'.		Use values specified in the 'conditions of use' with the certificate.
3b.		Certificate has no suffix.		Use the values specified in the standard used.
4a	Certification body policy required that suffix 'X' was marked where the test gap was less than the values in the standard used.	Certificate has suffix 'X'.		Use values specified in the 'conditions of use' with the certificate.
4b		Certificate has no suffix.		Use the values specified in the standard used.
5.	Relevant dimensions accurately determined by measurement of the equipment in 'as new' condition			Use the values determined by measurement.
6.	Relevant dimensions accurately determined from identical undamaged equipment			Use the values determined by measurement.
7.	Relevant dimensions accurately determined from undamaged parts of the equipment			Use the values determined by measurement.
8.	Relevant dimensions accurately determined from partially damaged parts of the equipment			Use the values determined by measurement.
9.	Other method by which the original dimensions are accurately determined			Use the values so determined.
10a	Other conditions [b c d]	Cylindrical joints for shaft glands of rotating electrical machines with rolling-element bearings		Use 80 % of the value specified in the current edition of IEC 60079-1.
10b		Other joints	40 % of the appropriate value in the current edition of IEC 60079-1 is smaller than the credible manufacturing gap	Use the smallest credible manufacturing gap.
10c			40 % of the appropriate value in the current edition of IEC 60079-1 is greater than the credible manufacturing gap.	Use 40 % of the value specified in the current edition of IEC 60079-1.

[a] The 'original standard' is the edition of the standard to which the equipment was certified.

[b] The reduced gap (80 % or 40 %) is only applicable to damaged parts subject to reclamation.

[c] Where the reduced gap contravenes the requirements for the minimum radial gap 'k' and/or the maximal radial gap 'm', the required gap shall be the smallest that meets the 'k' and 'm' requirements.

[d] Damaged gaps on equipment in environments requiring Group IIC equipment cannot be reclaimed.

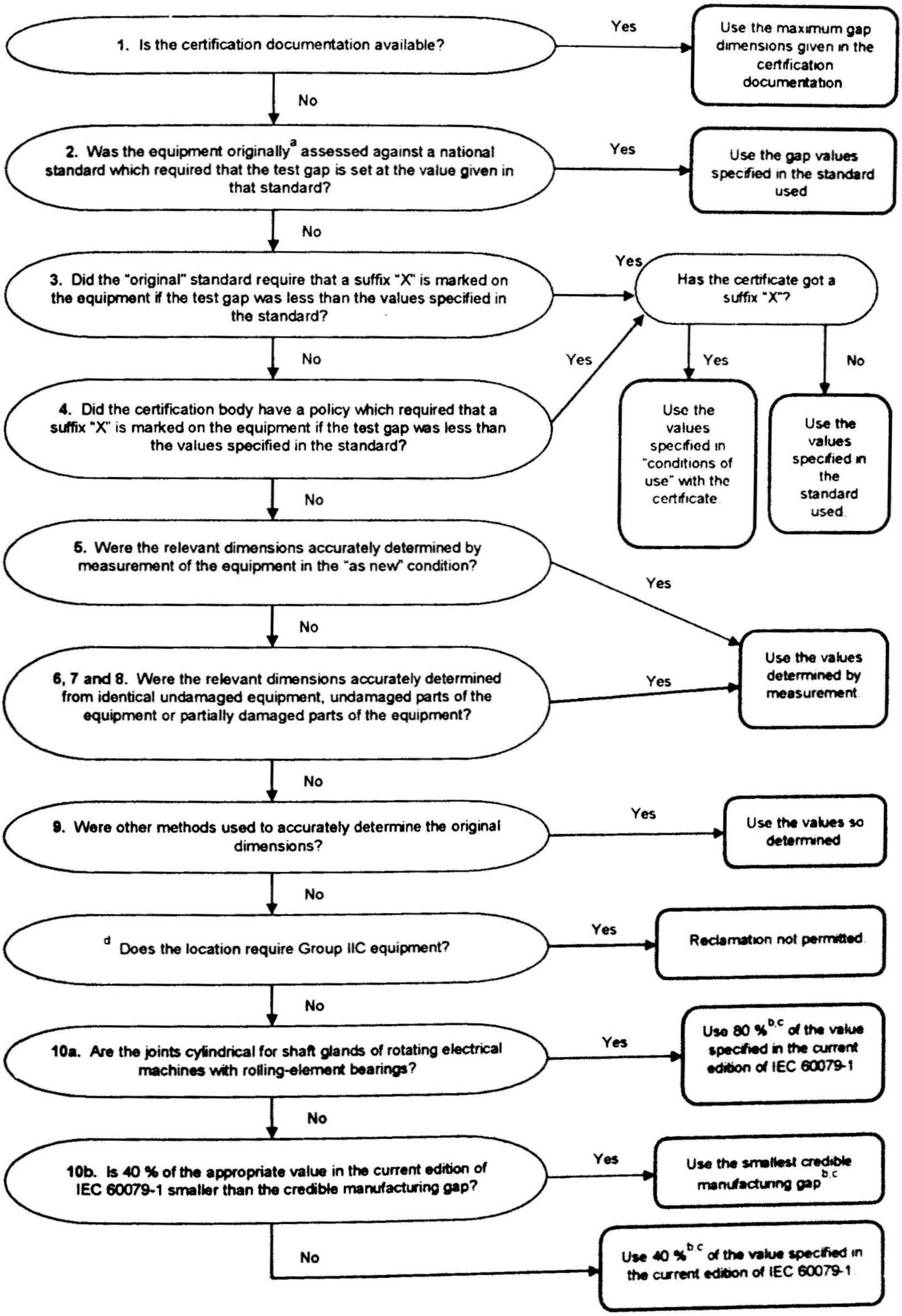

1. Is the certification documentation available?
Yes
Use the maximum gap dimensions given in the certification documentation
No
2. Was the equipment originally[a] assessed against a national standard which required that the test gap is set at the value given in that standard?
Yes
Use the gap values specified in the standard used
No
3. Did the "original" standard require that a suffix "X" is marked on the equipment if the test gap was less than the values specified in the standard?
Yes
Has the certificate got a suffix "X"?
Yes
Use the values specified in "conditions of use" with the certificate.
No
Use the values specified in the standard used.
No
Yes
4. Did the certification body have a policy which required that a suffix "X" is marked on the equipment if the test gap was less than the values specified in the standard?
No
5. Were the relevant dimensions accurately determined by measurement of the equipment in the "as new" condition?
Yes
Use the values determined by measurement.
No
6, 7 and 8. Were the relevant dimensions accurately determined from identical undamaged equipment, undamaged parts of the equipment or partially damaged parts of the equipment?
Yes
No
9. Were other methods used to accurately determine the original dimensions?
Yes
Use the values so determined
No
[d] Does the location require Group IIC equipment?
Yes
Reclamation not permitted.
No
10a. Are the joints cylindrical for shaft glands of rotating electrical machines with rolling-element bearings?
Yes
Use 80 %[b,c] of the value specified in the current edition of IEC 60079-1
No
10b. Is 40 % of the appropriate value in the current edition of IEC 60079-1 smaller than the credible manufacturing gap?
Yes
Use the smallest credible manufacturing gap[b,c]
No
Use 40 %[b,c] of the value specified in the current edition of IEC 60079-1.

Figure C.1 – Determination of maximum gap of reclaimed parts

(*Continued from second cover*)

International Standard	*Title*
IEC 61241-2	Electrical apparatus for use in the presence of combustible dust — Part 2: Test methods

Only the English language text has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc: No. ETD 22 (5727).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *website* : www.bis.org.in

Regional Offices: Telephones

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi
KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 — 260 3843, 260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed at Simco Printing Press, Delhi